

different, but have the same pressure, the reduced volumes of the gases diffused in opposite directions through the septum are inversely as the square roots of their specific gravities.

If one or both of the vessels is of invariable volume, the interchange of gas will cause an inequality of pressure, the pressure becoming greater in the vessel which contains the heavier gas.

If a vessel contains a mixture of gases, the gas diffused from the vessel through a porous septum will contain a larger proportion of the lighter gas, and the proportion of the heavier gas remaining in the vessel will increase during the process.

The rate of flow of a gas through a long capillary tube depends upon the viscosity or internal friction of the gas, a property quite independent of its specific gravity.

The phenomena of diffusion studied by Dr. v. Wroblewski are quite distinct from any of these. The septum through which the gas is observed to pass is apparently quite free from pores, and is indeed quite impervious to certain gases, while it allows others to pass.

It was the opinion of Graham that the substance of the septum is capable of entering into a more or less intimate combination with the substance of the gas; that on the side where the gas has greatest pressure the process of combination is always going on; that at the other side, where the pressure of the gas is smaller, the substance of the gas is always becoming dissociated from that of the septum; while in the interior of the septum those parts which are richer in the substance of the gas are communicating it to those which are poorer.

The rate at which this diffusion takes place depends therefore on the power of the gas to combine with the substance of the septum. Thus if the septum be a film of water or a soap bubble, those gases will pass through it most rapidly, which are most readily absorbed by water, but if the septum be of caoutchouc the order of the gases will be different. The fact discovered by St. Claire-Deville and Troost that certain gases can pass through plates of red hot metals, was explained by Graham in the same manner.

Franz Exner¹ has studied the diffusion of gases through soap bubbles, and finds the rate of diffusion is directly as the absorption-coefficient of the gas, and inversely as the square root of the specific gravity.

Stefan² in his first paper on the diffusion of gases has shown that a law of this form is to be expected, but he says that he will not go further into the problem of the motion of gases in absorbing medium, as it ought to form the subject of a separate investigation.

Dr. v. Wroblewski has confined himself to the investigation of the relation between the rate of diffusion and the pressure of the diffusing gas on the two sides of the membrane. The membrane was of caoutchouc, 0.0034 cm. thick. It was almost completely impervious to air. The rate at which carbonic acid diffused through the membrane was proportional to the pressure of that gas, and was independent of the pressure of the air on the other side of the membrane, provided this air was free from carbonic acid. The connection between this result and Henry's law of absorption is pointed out.

¹ "Pogg. Ann.," Bd. 155.

² "Ueber das Gleichgewicht u. d. Diffusion von Gasgemengen." Sitzb. der k. Akad. (Wien), Jan. 5, 1871.

The time of diffusion of hydrogen through caoutchouc is 3.6 times that of an equal volume of carbonic acid. The diffusion of a mixture of hydrogen and carbonic acid takes place as if each gas diffused independently of the other at a rate proportional to the part of the pressure which is due to that gas.

We hope that Dr. v. Wroblewski will continue his researches, and make a complete investigation of the phenomena of diffusion through absorbing substances.

J. CLERK MAXWELL

MACALISTER'S "ANIMAL MORPHOLOGY"

An Introduction to Animal Morphology and Systematic Zoology. Part I.—Invertebrata. By Prof. Alexander Macalister, M.B. (Longmans, Green, and Co., 1876.)

HOW many of those who are not of an extra systematic turn of mind, when they review their reading in any special line of research, have continually to regret that they have not had the industry to abstract as well as to classify the various monographs and papers they have perused, and to preserve them in a united form for future reference. Those of us who are zoologists may lay aside some of our misgivings on this score; for one among us, an exhaustive reader and an acute appreciator of the relative importance of facts, has so widely distributed his literary investigations, at the same time that he has made it a principle to keep a memorandum of those points which have most impressed him, that he has felt justified—quite correctly, as all his readers we are convinced will agree—in placing his compilation at the disposal of the scientific public. The volume on the Invertebrata, now before us, fills between four and five hundred closely printed octavo pages.

It is evident that a work constructed on the principles above indicated must be of too exhaustive and too abstruse a nature for the commencing student. It would be impossible for any author so to combine primary definitions and first principles with elaborate detail as to produce a book which would appeal to the tyro as well as the advanced zoologist. Prof. Macalister's "Introduction to Animal Morphology" must be therefore looked upon as an introduction to the science proper, to be read by the second-year student, or to be interleaved for further annotation by the specialist. To teachers of Zoology it will be found invaluable on account of the great fund of information it contains in a highly condensed form, also because in nearly all cases the *name* of the authority for each important fact is associated (in brackets) with his observation. In such a work we think that no better method could have been employed. It would have greatly overloaded the pages if full references had been given; and now that the invaluable Catalogue of Scientific Papers, published by the Royal Society—in which the publications are arranged under the *names* of authors—is within reach of all, in the libraries of the learned societies, if not elsewhere, it is a matter of no great difficulty for anyone who is particularly interested in any special detail, to find which is, and refer to, the monograph or shorter communication in which the point in question is embodied.

There is a small detail in association with the printing of the work, a modification of which in the second volume

would be an immense advantage. Prof. Macalister heads each page with the words, "Introduction to Animal Morphology." In so doing he seems to have entirely overlooked the fact that the object of the heading is to give some notion as to what is to be found below it, and not the title of the work itself. Why he has not followed the ordinary method of placing on the top of one of each two pages the subject of the chapter, and on the other further detail, we are at a loss to understand, and suffer accordingly in attempting to make any particular reference.

The first seven chapters of Prof. Macalister's work are on general subjects: protoplasm, general morphology, histology, tectology (individuality and the formation of organs), reproduction, and the distribution of animals. There are certain statements in the last of these with which we cannot quite agree. That Patagonia should be entirely removed from the Neotropical Region and placed together with the Southern Circumpolar Land in a special Antarctic, seems very much at variance with known facts. Why the Polar Bear should be only mentioned in association with the Nearctic Circumpolar Region; the Aard-vark, Manis, and Manatee with the Guinean; the Catarrhine Monkeys with the Indian; Bennett's Cassowary with the Australian; the Birds of Paradise with the Indo-Malay, we are at a loss to comprehend.

In association with the doctrine of the origin of species we are told that, "as a natural deduction from evolution, we have *Dr. Houghton's* law, that all structures are arranged so as to give the maximum of work possible under the given external conditions." This law is, however, a natural deduction from the theory of natural selection, not from evolution; it not being evolution, *per se*, but the struggle for existence which brings to the foreground the most economical animal machinery. It may also be mentioned that there are still wanting some important links in the chain of reasoning which explains the diminution of organs, like the wings of birds, in small islands. These seem to be lost on account of the reduction of the struggle for existence, mammals not being on the ground to contest the field. *Dr. Houghton's* law, therefore, no longer applies apparently. Why then are the wings lost?

The classification adopted is that of Haeckel modified, the Metazoa being primarily divided into the two sub-series, Polystomata (Sponges) and Monostomata; the Cœlenterata being removed from the Porifera, and included with the other forms in which there is but one aperture of ingress into the body-cavity. No very special stress is laid on the vertebrate affinities of the Tunicata, which are included in the sub-kingdom Vermes. Of their development we read that "in *Ascidia* and *Phallusia* the segmented yolk assumes its mulberry form, hollows within, and appears as a spherical, cellular body (blastula); a groove indents one side of this; the lips of the groove rise and close it in, except in one spot, and thus the body becomes bicavitary, the dorsal groove contracts, and the nerve ganglion develops either within it or in its close vicinity. On a plane between the dorsal neural cavity thus formed and the ventral space, a double row of large cells appears, which extends into the tail, and forms an axis for that organ. These cells resemble those of the chorda dorsalis of Vertebrates, and have a similar relation

to the neural and visceral cavities of the primarily bicavitary body to that possessed by the dorsal chord. Upon these phenomena, observed by Kowalewsky, Kupffer, and others, is rested the theory of relationship of Tunicates and Vertebrates, which is strengthened by the setting apart here of a portion of the digestive canal for respiratory purposes." This quotation illustrates the condensed manner in which the whole work is written and the way in which single words are frequently modified to do the duty of whole sentences. As a second illustration of the same method when employed with reference to the sub-kingdom Cœlenterata, one in which name-coining has arrived at a worse pitch even than in systematic botany—the following sentence will suffice:—"The alternation of generations may be binary (hydranth, gonophore, + hydranth, gonophore, &c.), or ternary (hydranth, blastostyle, gonophore, + *h, b, g*, &c.), or quaternary (hydranth, blastostyle, blastocheme, gonocheme, + *h, b, g*, &c.); or even more complex if the hydranths be heteromorphic." The Mollusca are treated of between the Vermes and Arthropoda, it being remarked of them that "their structure can be easily understood by regarding them as Vermes with no articulated appendages, modified by unequal lateral development, and by a fusion of the metameres," although "we know as yet of no absolute passage forms or direct synthetic types." This being the case, we cannot understand how each of these major groups can be regarded as a sub-kingdom.

The author, in his preface, regrets that, owing to the long time that the work (written in 1873) has been going through the press, he has not been able to introduce into it references to recent discoveries, which explains several important omissions. Notwithstanding this, we are convinced that all zoologists will agree that the work is a most valuable addition to the literature of general animal morphology.

OUR BOOK SHELF

Introductory Text-book of Physical Geography. By David Page. Eighth Edition. (Blackwood and Sons, 1876.)

INTRODUCTORY text-books on Physical Geography are not numerous, and if we may judge by the calls for new editions, this one is growing in favour. It certainly gives in a short and handy form the most important facts of the subject—and in the descriptive part it is merely a question of the selection of the most important, and in this respect we think the selection judicious, as indeed it would appear to have been found. *Dr. Page* comes to Physical Geography from the side of Geology, and his readers reap the benefit of it, in the chapters relating to the structure of the earth, and to the work of rivers, and to the positions of mountain ranges, which are very good. In many other respects too, the book is worthy of the support it receives, the facts being told clearly, concisely, and for the most part truly.

We cannot help, however, drawing attention to one or two points which we think would at least have been differently worded if the author had approached his subject from a physical side in his explanation of phenomena. Thus we are told with reference to water, that "when converted into steam it occupies 1,696 times more space with a specific gravity of only '622.'" The only standard of specific gravity mentioned is water at 62° F., and a physicist might ask at what pressure is the steam?

Again, we read, "the atmosphere being the medium